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RESEARCH ARTICLE

New tachinid parasitoids (Diptera: Tachinidae) on pine processionary moth (*Thaumetopoea pityocampa*) in Bulgaria

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Abstract

The tachinid parasitoids (Diptera: Tachinidae) of the pine processionary moth (*Thaumetopoea pityocampa*) were studied in 2019 and 2020 in the Eastern Rhodopes (Fotinovo, Kandilka and Sarnak vills.), the Western Rhodopes (Dobrostan vill.) and the Struma Valley (town of Sandanski). In total, 1193 larvae and pupae of *T. pityocampa* were collected in 40-50-year-old *Pinus nigra* plantations. They were transported and observed in laboratory conditions at 20-22 °C. Three parasitoids, *Compsilura concinnata*, *Exorista* (*Exorista*) *fasciata* and *Phryxe vulgaris* were reared from the host. In this study, *E. fasciata* was established for the first time in trophic association with *T. pityocampa*. In addition, *P. vulgaris* was confirmed as a parasitoid of the host. The mortality of the pine processionary moth caused by tachinids in different localities was 0.5-5.3%, with an average of 2.6% for the country.

Keywords

Pine processionary moth, Tachinidae, *Exorista fasciata*, new parasitoid, Bulgaria

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Introduction

The pine processionary moth *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775) (Lepidoptera: Notodontidae) is one of the most common and dangerous defoliating insects in pine forests in the Mediterranean (Battisti et al., 2015). In Bulgaria, the pest attacks approximately 5000-27000 ha per year (Mirchev et al., 2018).

Two different phenological forms of *T. pityocampa* were established in Bulgaria: a typical Mediterranean late developing form, distributed in the region of Sandanski and Ivaylovgrad, and an early developing form in some localities in the Rhodopes Mts. (Georgieva et al., 2018; Mirchev et al., 2019). The late developing form overwinters as a larva in the nests, and the early developing form – as a pupa in the soil. The summer form larvae complete their development and descend into the soil for pupation in the end of October (Georgieva et al., 2019).

Many parasitoids and predators regulate the population density of *T. pityocampa*. In Bulgaria, egg parasitoids have been extensively studied for many years. As a result, 9 species of 4 hymenopteran families (Encyrtidae, Eulophidae, Eupelmidae and Trichogammatidae) have been established to reduce the host's number up to 45% (Tsankov et al., 1996a, 1996b, 1998; Mirchev et al., 1998, etc.). In contrast, larval and pupal parasitoids of the host have been significantly less studied, most likely due to the strong allergic impact of the pine processionary moth.

This note reports new records of pupal parasitoids of *T. pityocampa* in Bulgaria.

Materials and methods

The investigations were conducted in five localities of pine processionary moth in Bulgaria: Fotinovo vill., Kandilka vill., Sarnak vill. (Eastern Rhodopes, Central South Bulgaria), Dobrostan vill. (Western Rhodopes, Central South Bulgaria) and the town of Sandanski (Sruma Valley, Southwestern Bulgaria).

The biological material (1193 larvae and pupae of *T. pityocampa*) was collected in 40-50-year-old plantations of *Pinus nigra* Arn., after the larvae's descent into the soil for pupation (between 7 February and 22 May 2019, and on 31 January 2020) (Table 1).

After collection, the larvae and pupae were transported to the Forest Research Institute in Sofia. In laboratory conditions, they were put in plastic boxes with size 20 x 15 x 10 cm covered with moist, sterile sand. The biological material was kept at room temperature (20-22 °C) in groups of 20-50 specimens per box.

The samples were monitored daily. The emerged parasitoids were separated in test tubes for identification by the keys of Mesnil (1944-1975) and Tschorsnig, Herting (1994).

The biological material is deposited in the entomological collection of Natural Museum of Natural History in Sofia.

Table 1. Main characteristics of studied sites and biological material collected

Site	Coordinates	Altitude, m	Date of collection	Stage of the host	Number
Fotinovo	41°22'37.50"N 25°19'18.50"E	450	07 Feb 2019	larvae	88
				pupae	594
			26 Mar 2019	pupae	179
Kandilka	41°24'33.80"N 25°34'53.20"E	460	26 Mar 2019	pupae	157
Sarnak	41°25'50.50"N 25°36'24.20"E	465	26 Mar 2019	larvae	114
Sandanski	41°31'11.10"N 23°16'23.40"E	127	22 Mar 2019	larvae	42
Dobrostan	41°53'45.50"N 25°55'46.40"E	1121	31 Jan 2020	larvae	1
				pupae	18

Results

Three tachinid (Diptera: Tachinidae) parasitoid species were reared from *T. pityocampa* larvae and pupae: *Compsilura concinnata* (Meigen, 1824), *Exorista* (*Exorista*) *fasciata* (Fallén, 1820) and *Phryxe vulgaris* (Fallén, 1810) (Table 2).

In this study, *E. fasciata* was established for the first time in trophic association with pine processionary moth as a parasitoid of larvae and pupae of the host.

Exorista fasciata differs from the other two known parasitoid species of *T. pityocampa*, *Exorista* (*Exorista*) *segregata* (Rondani, 1859) and *Exorista* (*Ptilotachina*) *xanthaspis* (Wiedemann, 1830), by the following special features: naked eyes; tergites dusted up to ½ of the length; abdomen with black longitudinal streak; all black fifth tergite; the largest width of the cerci at their base. The other mentioned species have a different combination of features: *E. xanthaspis* has red end of the fifth tergite, and *E. segregata* – hairy eyes and different morphology of the cerci.

Table 2. Emerged tachinid parasitoids and impact on the host in different localities

Species	Site	Emerged insects	Emergence date	Parasitism, %
Compsilura concinnata	Fotinovo	2 ♂♂, 2 ♀♀	13-14 Mar 2019	0.5
	Dobrostan	1 ♂	09 Mar 2020	5.3
Exorista fasciata	Fotinovo	4 ♂♂, 15 ♀♀	13 Mar-30 Apr 2019	2.2
Phryxe vulgaris	Kandilka	4 ♂♂, 2 ♀♀	24-27 Aug 2019	2.5
	Sandanski	1 ♂	16 Nov 2019	2.4
-	Sarnak	-	-	0.0
Total		12 ♂♂, 19 ♀♀		2.6

The parasitism of *T. pityocampa* caused by tachinid species in Fotinovo, Kandilka, Sandanski and Dobrostan was low – 0.5-5.3% (Table 2). No parasitoids were found in the fifth locality (Sarnak), and the average host mortality caused by tachinids in studied localities was 2.6%.

Discussion

In Bulgaria, four tachinid species were reported as parasitoids of *T. pityocampa*. Russkoff (1930) pointed out that *Compsilura concinnata* and *Exorista* (*Exorista*) *segregata* (Rondani, 1859) destroy 2-5% of the host population in the Western Rhodopes. In the region of Ploski vill. (Pirin Mt. in Southwestern Bulgaria), *Phorocera grandis* (Rondani, 1859) was observed to lay eggs on *T. pityocampa* larvae, and *Phryxe vulgaris* (Fallén, 1810) was reared from host pupae (Hubenov, 1983).

Exorista fasciata is connected with 49 hosts from 11 lepidopteran families (Tschorsnig, 2017). No hosts of the parasitoid from Notodontidae (incl. Thaumetopoeinae subfamily), were known until the present study. In Bulgaria, *E. fasciata* was reared only from *Lymantria dispar* (Linnaeus, 1758) (Lepidoptera: Erebidae) (Hubenov, 1985).

Compsilura concinnata is highly polyphagous with a wide range of hosts (289 hymenopteran and lepidopteran species, including 8 representatives of *Thaumetopoea* genus) (Tschorsnig, 2017). With the exception of *T. pityocampa*, in Bulgaria it was reared from *T. processionea* (Linnaeus, 1758) and *T. solitaria* (Freyer, 1838) (Hubenov, 1985).

Phryxe vulgaris is a generalist to over 180 hosts from Coleoptera, Hymenoptera and Lepidoptera orders. Tschorsnig (2017) suggested that the reporting of the species as a parasitoid of the pine processionary moth in Ploski vill. in Bulgaria could be the result of a misidentification of *Phryxe caudata* (Rondani, 1859). However, *P. caudata* has not been found and reported in Bulgaria (Hubenov, 2008; O'Hara et al., 2020). In this study, parasitism of *P. vulgaris* on *T. pityocampa* was confirmed in two more localities of the host (town of Sandanski and Kandilka vill.).

With the exception of the above-mentioned species (*E. segregata*, *E. xanthaspis*, *P. grandis*, *P. vulgaris*, *P. caudata* and *C. concinnata*), other tachinids have also been reported as parasitoids of *T. pityocampa*: *Blondelia nigripes* (Fallén, 1810), *Carcelia iliaca* (Ratzeburg, 1840) and *Pales pavida* (Meigen, 1824) (Tschorsnig, 2017).

In the present study, *C. concinnata*, *E. fasciata* and *P. vulgaris* were established at lower frequencies. Low rates of parasitism of the pine processionary moth caused by tachinid species have been reported in Italy (*P. caudata* – 0.9-2.6%) (Bonsignore et al., 2015) and Algeria (*P. caudata*, *C. concinnata* and *E. segregata* – 5-10%) (Battisti et al., 2015). Low mortality caused by tachinid species (0.3-4.6%) was also reported for the cedar processionary moth, *Traumatocampa ispartaensis* (Doğanlar & Avci, 2001) in Turkey (Avci, Kara 2002). This is probably due to the low activity of the parasitoids in late autumn (end of October) and early spring (March-April) during descending of *T. pityocampa* larvae into the soil for pupation.

In conclusion, the results of this study expand the knowledge on parasitoid complex of pine processionary moth and the host range of *Exorista fasciata*.

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